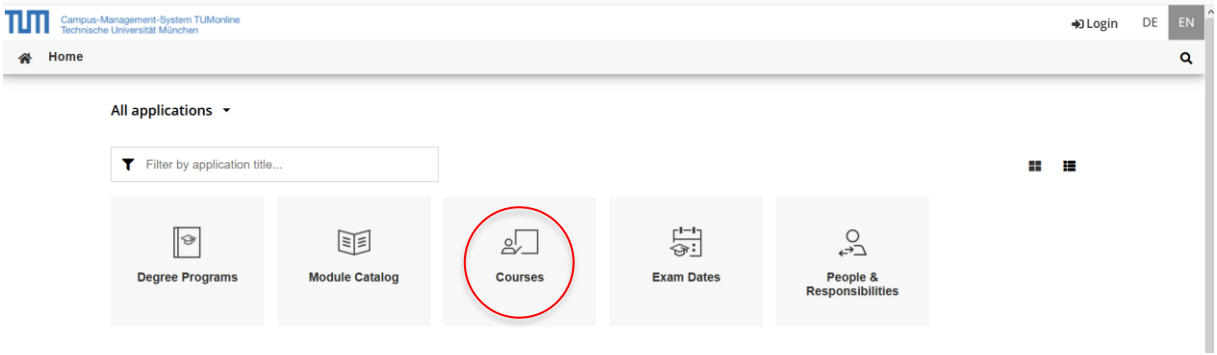
Guideline for Choosing Courses

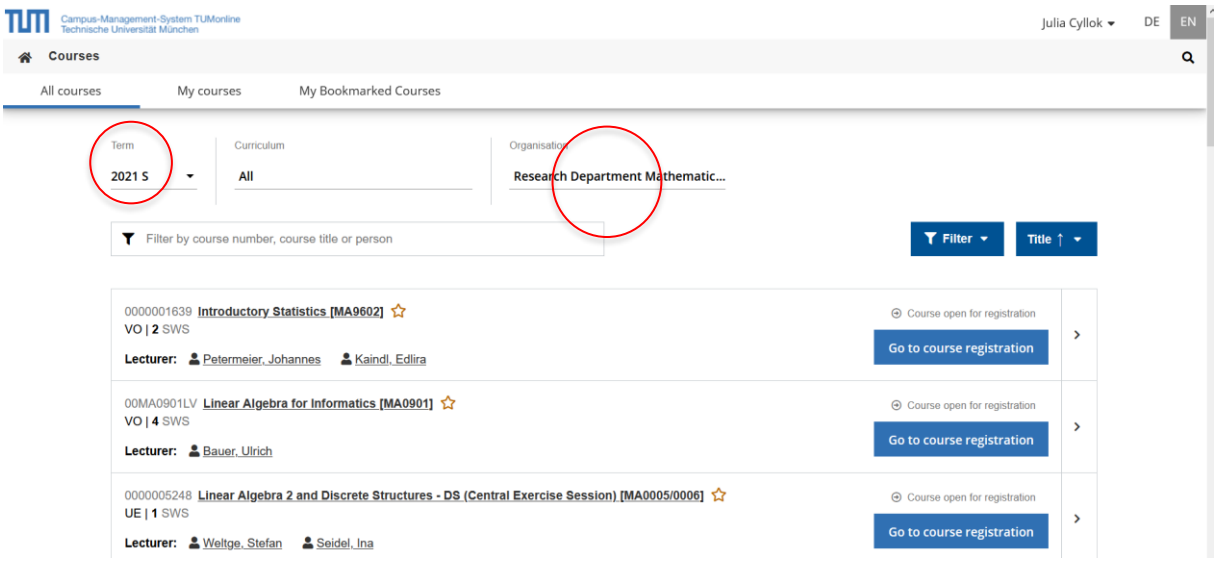
TUM Department of Mathematics – March 2021

1. General information

To find out about offered courses, see module descriptions or to sign up for lectures, exercises and exams, you will use www.campus.tum.de , also known as TUMonline.
This is how the start page will look like. At the top right corner, you can change the language to English if necessary.



If you want to know which courses are currently offered, please choose *Courses*. Under Organization, you can select *Research Department Mathematics Center (Zentrum Mathematik)* and then you will see all the *Courses* (*Lehrveranstaltungen*) offered at our department in the selected *Term (Semester)*:



2. List of regularly offered courses

The following list is an overview of regularly offered a) graduate and b) undergraduate modules. Additionally, our department offers a lot of special modules with different topics each semester. These special modules might be offered every year as well, but it is also possible that they are offered irregularly, every two years or even only one- time (see 3.). The regular workload per term at TUM is 30 ECTS (Credits).

The list of courses is displayed in TUMonline only 4-6 weeks in before the semester starts.

The following classification is not mandatory, but just to be understood as an overview (orientated at the classification from the M.Sc. Mathematics). In general, the meaning of the alphanumerical ID for each course is as follows:

MA	Course offered by the mathematics department
0xxx	Basic and fundamental courses
1xxx	expired modules or only suitable for teaching degree students
2xxx	complementary and specialization modules
3xxx-4xxx	Advanced courses
5xxx	Specialized master's courses (mainly offered irregularly)
9xxx	Service lectures for other departments

Courses with ID 0xxx and 2xxx are mostly bachelor's modules and hence offered in German. The other modules are master's level courses where the language of instruction is mostly English. If you plan to attend German taught classes we recommend a minimum level of B2 in German.

a) Graduate / master's courses

Analysis

Module Number	Name	ECTS (credit points)	WiSe / SuSe	Teaching Language	Academic hours per week*
MA3001	Functional Analysis	9	WiSe	English	4L+2E
MA3005	Partial Differential Equations	9	WiSe	English	4L+2E
MA3080	Introduction to Nonlinear Dynamics	5	WiSe	English	2L+1E
MA3081	Dynamical Systems	9	SuSe	English	4L+2E

Algebra, Geometry

Module Number	Name	ECTS (credit points)	WiSe / SuSe	Teaching Language	Academic hours per week*
MA3205	Differential Geometry - every 2 years	9	WiSe 2020/21	English	4L+2E
MA5120	Algebra 2	9	WiSe	English	4L+2E

Probability, Statistics and Financial Mathematics

Module Number	Name	ECTS (credit points)	WiSe / SuSe	Teaching Language	Academic hours per week*
MA3403	Generalized Linear Models	9	WiSe	English	4L+2E
MA3411	Time Series Analysis	9	WiSe	English	4L+2E
MA3701	Discrete Time Finance	6	WiSe	English	2L+1E (+2E)
MA4401	Applied Regression	5	WiSe	English	2L+1E (+1E)
MA4405	Stochastic Analysis	6	WiSe	English	3L+1E
MA3703	Fixed Income Markets	5	WiSe	English	2L+1E
MA3442	Actuarial Risk Theory	5	SuSe	English	2L+1E
MA2409	Probability Theory	9	WiSe	English	4L+2E
MA3402	Computational Statistics	5	SuSe	English	2L+1E
MA3702	Continuous Time Finance	6	SuSe	English	2L+2E
MA4472	Multivariate Statistics	5	SuSe	English	2L+1E
MA4406	Probability on Graphs	5	SuSe	English	2L+1E
MA4408	Markov Processes	9	SuSe	English	4L+2E
MA4706	Portfolio Analysis	6	SuSe	English	2L+1E
MA3405	Insurance Mathematics 1	9	WiSe	English	4L+2E
MA3406	Insurance Mathematics 2	9	SuSe	English	4L+2E

Every 2 years only					
MA5415	Quantitative Risk Management	5	WiSe 2021/22	English	2L+1E
MA3452	Actuarial Mathematics for Pensions	3	WiSe	English	2L

Numerics, Optimization and Model Building

Module Number	Name	ECTS (credit points)	WiSe / SuSe	Teaching Language	Academic hours per week*
MA3303	Numerical Methods of PDEs	9	WiSe	English	4L+2E
MA3502	Discrete Optimization	5	WiSe	English	2L+1E
MA3601	Mathematical Models in Biology	9	WiSe	English	4L+2E
MA3503	Nonlinear Optimization: Advanced	5	WiSe	English	2L+1E
MA4502	Combinatorial Optimization	5	SuSe	English	2L+1E
MA4503	Modern Methods in Nonlinear Optimization	5	SuSe	English	2L+1E
MA3602	Advanced Mathematical Biology	9	SuSe	English	4L+2E
MA4800	Foundations of Data Analysis	8	SuSe	English	4L+2E
MA4512	Case Studies (Discrete Optimization)	7	SuSe	English	4L
MA4513	Case Studies (Nonlinear Optimization)	7	SuSe	English	4L
MA4306	Case Studies (Scientific Computing)	6	WiSe/SuSe	English	2L(+2E)

Every 2 years only					
MA4803	Probabilistic Techniques and Algorithms in Data Analysis	6	WiSe 2020	English	2L+2E

MA4801	Mathematical Foundations of Machine Learning	6	SuSe 2022	English	2L+2E
MA4802	Statistical Learning	6	SuSe 2022	English	2L+2E
MA4302	Computational Inverse Problems	6	SuSe 2021	English	3L+1E
MA4804	Geometry and Topology for Data Analysis	6	WiSe 2021	English	2L+2E

b) Undergraduate / bachelor's courses

Analysis

Module Number	Name	ECTS (credit points)	WiSe / SuSe	Teaching Language	Academic hours per week*
MA0003	Analysis 3	9	WiSe	German	4L+2E
MA3001	Functional Analysis	9	WiSe	English	4L+2E
MA3005	Partial Differential Equations	9	WiSe	English	4L+2E
MA3080	Introduction to Nonlinear Dynamics	5	WiSe	English	2L+1E
MA2006	Complex Analysis	5	SuSe	German	2L+1E

Algebra and Geometry

Module Number	Name	ECTS (credit points)	WiSe / SuSe	Teaching Language	Academic hours per week*
MA2010	Algebra	9	SuSe	German	5L+2E
MA2011	Geometry	9	SuSe	German	4L+4E

Probability, Statistics and Financial Mathematics

Module Number	Name	ECTS (credit points)	WiSe / SuSe	Teaching Language	Academic hours per week*
MA0009	Introduction to Probability and Statistics	9	WiSe	German	4L+2E
MA2404	Markov Chains	5	SuSe	German	2L+1E
MA3701	Discrete Time Finance	6	WiSe	English	2L+1E(+2E)
MA4401	Applied Regression	5	WiSe	English	2L+1E(+1E)
MA2409	Probability Theory	9	Wise	English	4L+2E
MA3402	Computational Statistics	5	SuSe	English	2L+1E

Numerics, Optimization and Model Building

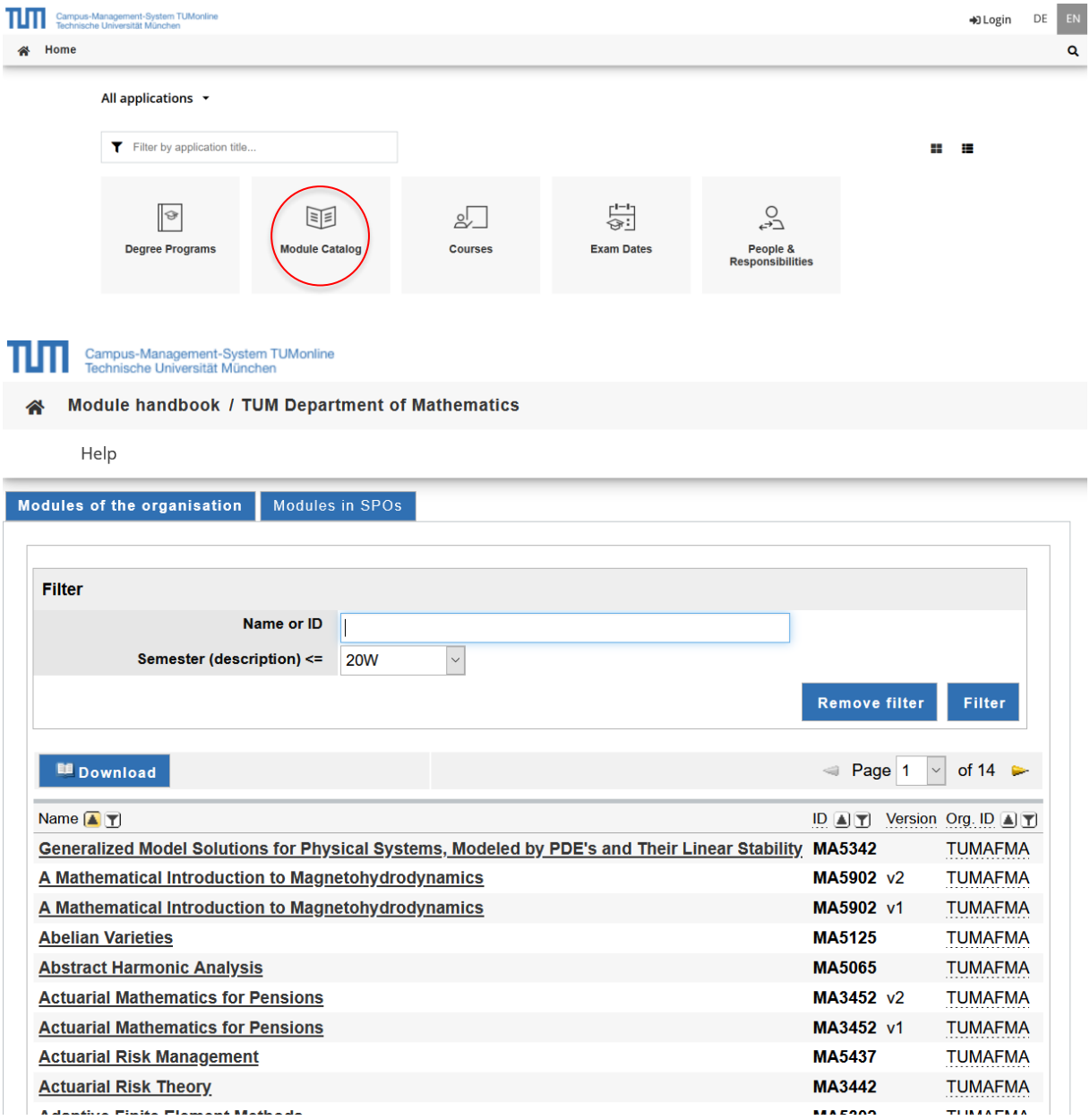
Module Number	Name	ECTS (credit points)	WiSe / SuSe	Teaching Language	Academic hours per week*
MA0008	Numerical Analysis	9	WiSe	German	4L+2E
MA3303	Numerical Methods for PDE's	9	WiSe	English	4L+2E
MA3503	Nonlinear Optimization: Advanced	5	WiSe	English	2L+1E

MA2012	Introduction to Optimization	9	SuSe	German	4L+4E
MA3502	Discrete Optimization	5	WiSe	English	2L+1E
MA3601	Mathematical Models in Biology	9	WiSe	English	4L+2E
MA2902	Case Studies: Mathematical Modelling	9	WiSe	German	4L+2E
MA2304	Numerics of Ordinary Differential Equations	9	WiSe	German	4L+2E

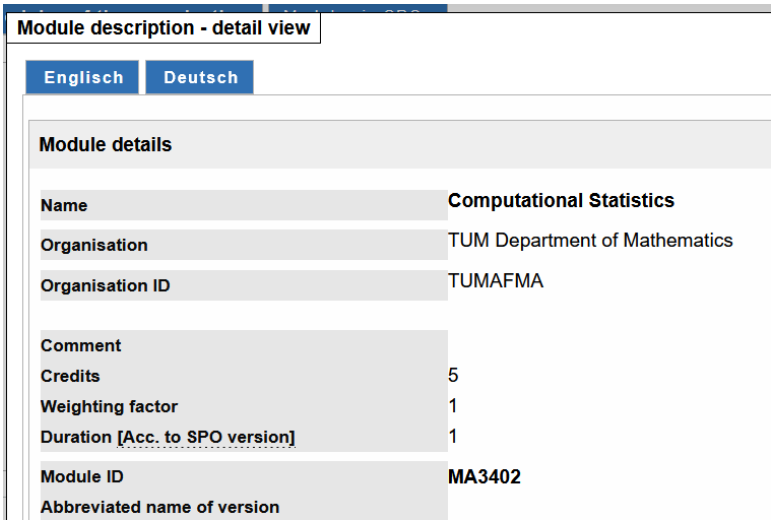
* 1 ECTS is equivalent to 30h workload per semester. L = Lecture, E = Exercise lesson

3. How to get specific information about each course – the *Module Catalogue*

If you want to have specific information about a course, you click on *Module Catalogue* and select *TUM Department of Mathematics*. There you can search with the course ID or the name.



To get detailed information for a course, you simply click on its name. Here you see the details of MA3402 Computational Statistics as an example.



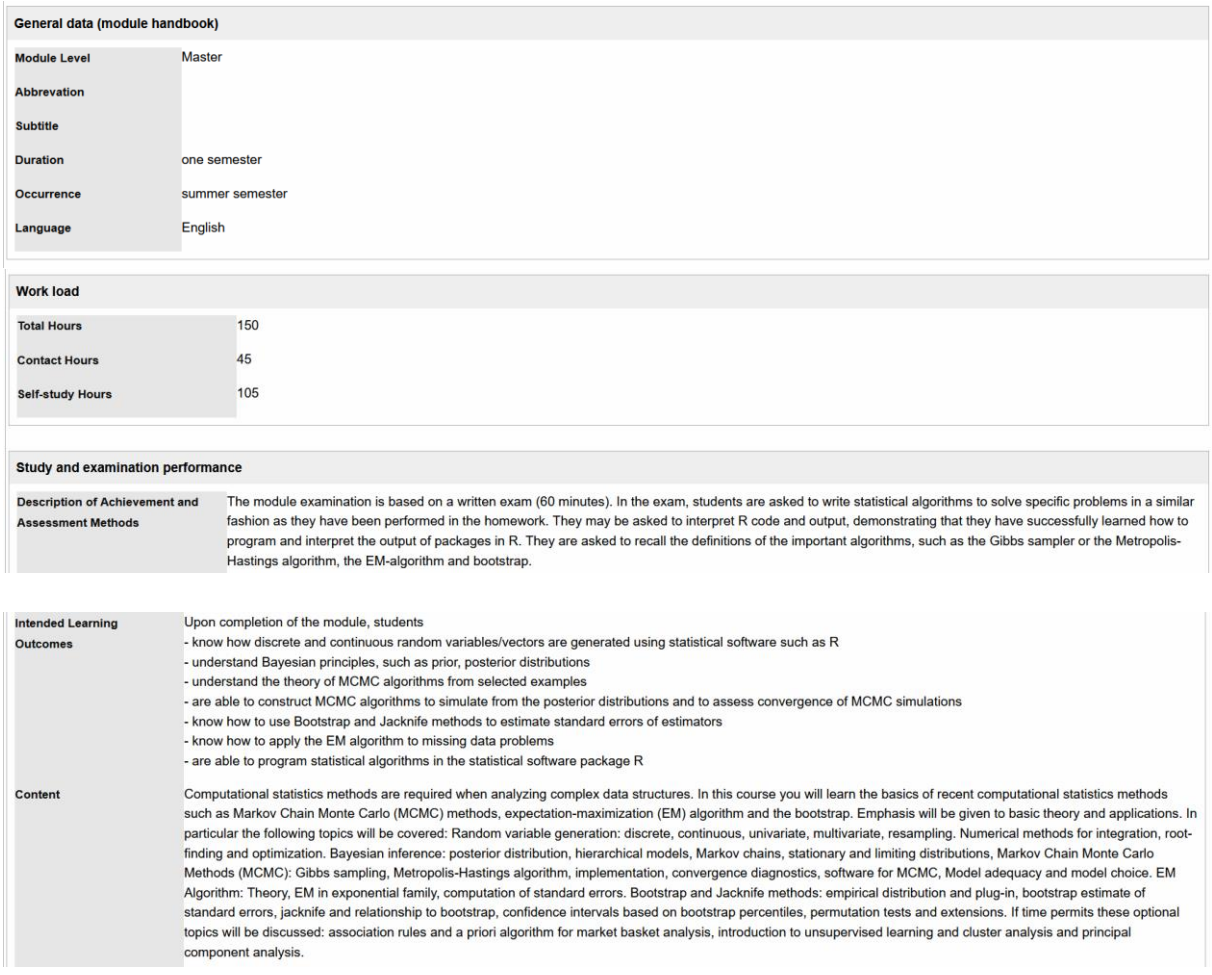
Module description - detail view

Englisch | Deutsch

Module details

Name	**Computational Statistics**
Organisation	TUM Department of Mathematics
Organisation ID	TUMAFMA
Comment	
Credits	5
Weighting factor	1
Duration [Acc. to SPO version]	1
Module ID	**MA3402**
Abbreviated name of version	

In the *Module Catalogue* you will find all relevant information like the ECTS, workload, level, occurrence, teaching language, content description, learning outcome and recommended literature.



General data (module handbook)

Module Level	Master
Abbrevation	
Subtitle	
Duration	one semester
Occurrence	summer semester
Language	English

Work load

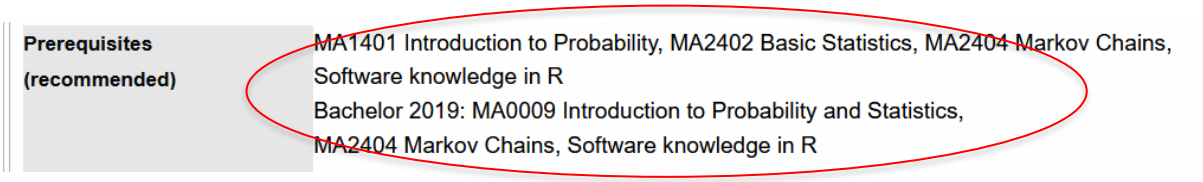
Total Hours	150
Contact Hours	45
Self-study Hours	105

Study and examination performance

Description of Achievement and Assessment Methods	The module examination is based on a written exam (60 minutes). In the exam, students are asked to write statistical algorithms to solve specific problems in a similar fashion as they have been performed in the homework. They may be asked to interpret R code and output, demonstrating that they have successfully learned how to program and interpret the output of packages in R. They are asked to recall the definitions of the important algorithms, such as the Gibbs sampler or the Metropolis-Hastings algorithm, the EM-algorithm and bootstrap.

Intended Learning Outcomes	Upon completion of the module, students - know how discrete and continuous random variables/vectors are generated using statistical software such as R - understand Bayesian principles, such as prior, posterior distributions - understand the theory of MCMC algorithms from selected examples - are able to construct MCMC algorithms to simulate from the posterior distributions and to assess convergence of MCMC simulations - know how to use Bootstrap and Jacknife methods to estimate standard errors of estimators - know how to apply the EM algorithm to missing data problems - are able to program statistical algorithms in the statistical software package R
Content	Computational statistics methods are required when analyzing complex data structures. In this course you will learn the basics of recent computational statistics methods such as Markov Chain Monte Carlo (MCMC) methods, expectation-maximization (EM) algorithm and the bootstrap. Emphasis will be given to basic theory and applications. In particular the following topics will be covered: Random variable generation: discrete, continuous, univariate, multivariate, resampling. Numerical methods for integration, root-finding and optimization. Bayesian inference: posterior distribution, hierarchical models, Markov chains, stationary and limiting distributions, Markov Chain Monte Carlo Methods (MCMC): Gibbs sampling, Metropolis-Hastings algorithm, implementation, convergence diagnostics, software for MCMC, Model adequacy and model choice. EM Algorithm: Theory, EM in exponential family, computation of standard errors. Bootstrap and Jacknife methods: empirical distribution and plug-in, bootstrap estimate of standard errors, jacknife and relationship to bootstrap, confidence intervals based on bootstrap percentiles, permutation tests and extensions. If time permits these optional topics will be discussed: association rules and a priori algorithm for market basket analysis, introduction to unsupervised learning and cluster analysis and principal component analysis.

Please note that you should meet the prerequisites for the courses you choose, otherwise it will be challenging to pass the exam in the end. Recommended prerequisites are also shown in the Module description:



Please be aware that only because the title and the information might be in English, this does NOT imply that the course is for sure offered in English. Binding is the language (of instruction) as written in the *General Data (module handbook)* section.

4. Tips for making up your study plan (also Learning Agreement):

1. Search for courses in the *module catalogue* (not under *courses*) and click on the course's name you are interested in for the details.
2. Check whether the course has the level you want and find out about the occurrence, ECTS, language of instruction and content.
3. To be safe regarding the occurrence it is recommendable to stick to the regular modules mentioned above. Modifications can be be made later!
4. In your own interest: please make sure you meet the prerequisites for each chosen course.
5. Be aware that sometimes you will have to change the subjects again when you come to TUM.
6. Please note that 60% of your courses have to be from the Mathematics department , only 40% from other departments (language courses do not count).

If you have further questions please feel free to contact Ms. Julia Cyllok, our International Student Advisor: international@ma.tum.de